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A REVIEW OF INDUSTRIAL SOLID WASTES

A Division of Technical Operations
Open-File Report (TO 5.0/0)

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CONCLUSIONS

Industrial solid waste is a major problem to industry and to the community. Acceptable collection and proper disposal of industrial solid wastes is needed whether it takes place within the plant, within the surrounding community, or outside the communities boundaries. Solid wastes generated by industrial plants can be minimized by efficient management. Storage and collection of industrial wastes are usually the responsibility of the plant or private contractor. Waste disposal can be either the responsibility of the plant, a private contractor, or the municipality.

Surveys have shown that industrial solid wastes quantities vary markedly from plant to plant. The types of the wastes are similar, with the exception of complex process wastes, and normally consist of paper, metal, wood, glass, rubber, and plastics.

It is difficult to generalize about industrial solid waste practices and needs because of the lack of information, the types and complexity of industrial processes, present practices of solid waste management, and apathy on the part of industry and the community regarding solid wastes. As is apparent in the entire field of solid wastes, the biggest problem is acceptable disposal procedures. But, the most desirable approach would be reuse or utilization of the wastes. In many cases industrial solid wastes are more amenable to reuse because they are already segregated into types to which a reclaiming process might be applied.

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A suggested approach to evaluating and solving the practices and problems for an individual plant or plant complex is as follows:

1. All available information on solid waste storage, collection, disposal, and utilization; costs and practices, manpower, and equipment usage should be collected. Knowledge of waste types and quantities is necessary for planning and deciding on disposal methods, and to determine whether reuse or reclaiming processes are feasible.
2. An evaluation of the present waste practices and costs will be needed along with additional data to fully understand the solid waste system. The majority of the data for analysis will come from step one.
3. All potential solutions and alternative approaches should be fully evaluated both technically and economically. All factors must be weighed to develop and select a sound solid waste management system or program.
4. The final step is the development and implementation of the selected system. Although future trends may be toward reuse and recycling, large volumes of industrial solid wastes will continue to be generated. Properly designed facilities and systems must be available and used to insure effective solid waste management.

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INTRODUCTION

The Bureau of Solid Waste Management (BSWM) is currently undertaking long-range studies to more precisely define problems and establish guidelines for acceptable industrial solid waste management. These studies will enable the Bureau to provide meaningful and informative technical assistance to individuals, municipal agencies and industrial groups having problems or questions dealing with industrial solid waste.

At present little information exists in the literature relating to industrial solid waste management. This report is intended to provide a summary of available information which has been collected by the Bureau. Results of several studies conducted through BSWM demonstration grants and surveys will be presented. This data will include both generation quantities and cost information.

Included in these surveys and investigations are the Combustion Engineering Survey¹, and the BSWM National Solid Waste Survey.² Both of these were nation-wide in scope with broad and generalized results. Several, more limited, surveys have been conducted. The surveys will be presented in a case history style, to give more complete understanding of the problems involved in industrial solid waste management.

Most of the information presented is based on Standard Industrial Classifications (SIC)³. For this reason a section of the report will be devoted to a discussion of the SIC concept.

STANDARD INDUSTRIAL CLASSIFICATION

The Standard Industrial Classification (SIC)³ was developed by the Department of Commerce for use in classifying establishments by the type of activity in which they are engaged. These classifications are used for the purposes of facilitating the collection, tabulation, presentation, and analysis of data relating to various establishments and for promoting uniformity and comparability in the presentation of statistical data collected by agencies of the United State Government, State agencies, trade associations, and private research organizations.

The Classification is intended to cover the entire field of economic activities: agriculture, forestry, and fisheries; mining; construction; manufacturing; transportation, communication, electric, gas, and sanitary services; wholesale and retail trade; finance, insurance, and real estate; services; and government. Two broad classes are distinguished: (1) "operating establishments" which constitute an economic unit producing goods or services; and (2) central administrative office and auxiliary units which manage or provide services for other establishments of the same company. This report will concentrate on operating establishments producing industrial goods.

Each establishment is assigned a two-digit, a three-digit, or a four-digit industry code according to the degree of detail of information which may be needed. The code is determined by the product or group of products produced or services rendered.

The reports in this study are limited to SIC Division D, "Manufacturing" (Table 1), in which the line of activity is defined in terms of the product, raw material, or the process used. Division D includes all establishments engaged in the chemical or mechanical transformation of inorganic or organic substances into new products. The establishments are usually described as plants, factories, or mills, and are characterized by material handling equipment and power-driven machinery. Plants assembling component parts of a manufactured product are considered manufacturing plants, and it is assumed that all manufacturing plants generate industrial solid waste.

GENERAL SURVEYS

Combustion Engineering Survey

Combustion Engineering, Inc. conducted a general study¹ on solid waste disposal needs and practices, under contract No. PH 86-68-163 for the Bureau of Solid Waste Management. The study included the

TABLE 1
STANDARD INDUSTRIAL CLASSIFICATION GROUPS ³
Division D, Manufacturing

Major Group Number

19	Ordnance and accessories
20	Food and kindred products
21	Tobacco manufacturers
22	Textile mill products
23	Apparel and other finished products made from fabrics and similar material
24	Lumber and wood products, except furniture
25	Furniture and fixtures
26	Paper and allied products
27	Printing, publishing, and allied industries
28	Chemicals and allied products
29	Petroleum refining and related industries
30	Rubber and miscellaneous plastic products
31	Leather and leather products
32	Stone, clay, glass, and concrete products
33	Primary metal industries
34	Fabricated metal products, except ordinance, machinery, and transportation equipment
35	Machinery, except electrical
36	Electrical machinery, equipment, and supplies
37	Transportation equipment
38	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks
39	Miscellaneous manufacturing industries

technical and economic aspects of solid waste management. A major portion of the study was devoted to establishing an inventory of data on industrial solid waste.

Data for the report was gathered by use of an industrial check list. The check list format is presented in the appendix for informational purposes and as an example of the type of information which might be desirable to collect on industrial solid waste management.

The major portion of the report deals with survey results, which are presented industry by industry. The specific industries reported upon are:

- | | |
|--------------------------------|---|
| 1. sawmills | 11. rubber |
| 2. paper | 12. glass |
| 3. foods | 13. asphalt roofing |
| 4. wooden containers | 14. mill work |
| 5. wood furniture & fixtures | 15. tanning |
| 6. auto & aircraft manufacture | 16. printing & publishing |
| 7. meat packing | 17. textiles |
| 8. chemicals | 18. apparels |
| 9. paints | 19. fabricated metal products & machinery except electrical |
| | 20. special waste types |

Standard Industrial Classification codes used in the report varied from two to four digits, thereby presenting a different degree of depth for each industry. Data from each industry is presented in a standard format except for those industries which have an unusual output

measure. For example, the lumber industry which measures output in board feet. A portion of the survey dealt with two special types of waste: (1) shipping and plant solid waste and (2) metal solid waste.

The following list is the type of information presented in the Combustion Engineering report.

1. SIC code is used and the number of interviews, total employees and data collected from prior work is also presented.
2. Waste types, sources, and other characteristics are discussed, when available.
3. Waste quantities are developed in terms of thousand pounds of waste per year per employee(Kpye). Mathematical manipulation is used to give the total waste generated by the industries. A percentage of the total waste was subtracted due to reuse, giving total waste for disposal. A product growth factor is then applied to obtain a 1975 prediction.
4. Disposal is divided into hauling by self, municipal, or contract; and ownership of ultimate disposal facility by self, municipal, or contract. The type of facility is identified.
5. Any trends, that were indicated from the interview or data predictions, are noted.

Tables 2 through 5 and Figures 1 and 2 are presented as examples of the data contained in Combustion Engineering's "Industrial Inventory". The report (SW-7c) in its entirety is available from the Bureau of Solid Waste Management.

Table 2 gives the estimated manufacturing solid waste generated in the United States for 1965. The break-down is based on two digit Standard Industrial Classifications. Table 2 also includes a ranking of manufacturing industry by quantity of solid waste generated. Note that in terms of quantities generated, lumber and wood products rank first, and that chemical and rubber products rank much lower. In terms of disposal problems it is conceivable that this order might be reversed.

Table 3 gives the estimated total industrial solid waste which must be disposed, on a state by state basis. Although the data is given on a total basis, saw mill waste may be obtained by subtracting the material to be disposed which is exclusive of saw mill waste from the total waste generated.

In Table 4 the scrap and waste quantities are given, along with a fraction of waste utilized. A fairly representative picture of the amount of material being recycled can be obtained from this table.

Figures 1 and 2 show the estimated total annual manufacturing solid waste generated for disposal in pounds and the estimated industrial solid waste generated in pounds/capita/day respectively. Both of the figures show spatial distribution of industrial and manufacturing solid waste.

Based on the Combustion Engineering report, a measure of the relative quantities of industrial solid waste generated both on an industry and geographic basis can be obtained. By examining this generation and disposal picture and investigating an equivalent marketing distribution for recycled waste, an assessment of the macro-economics of industrial solid waste recycle is possible. In addition, interregional and national comparisons of the present quantities of waste being recycled can be obtained.

TABLE 2

ESTIMATED MANUFACTURING SOLID WASTE GENERATION IN THE U.S. 1965¹

SIC Code		Waste for Disposal Million Pounds/Year	Rank
19	Ordnance and Accessories	711	20
20	Food and Kindred Products	14,260	3
21	Tobacco Manufacturers	813	18
22	Textile Mill Products	2,158	14
23	Apparel	719	19
24	Lumber and Wood Products, Except Furniture	76,107	1
25	Furniture and Fixtures	3,877	10
26	Paper and Allied Products	10,189	4
27	Printing, Publishing, Allied Industries	15,221	2
28	Chemicals and Allied Products	6,048	7
29	Petroleum Refining and Related Industries	1,148	17
30	Rubber and Miscellaneous Plastic Products	4,927	8
31	Leather and Leather Products	6,325	6
32	Stone, Clay, Glass and Concrete	4,915	9
33	Primary Metal Industries	3,503	11
34, 35	Fabricated Metal Products and Machinery	7,660	5
36	Electrical Machinery, Equipment, Supplies	3,047	13
37	Transportation Equipment	3,479	12
38	Instruments, Photographic and Optical Goods	1,665	16
39	Miscellaneous	<u>1,696</u>	15
	TOTAL	168,468	

TABLE 3

ESTIMATED TOTAL INDUSTRIAL SOLID WASTE FOR DISPOSAL BY STATE¹

State	Manufacturing		Manufacturing		All Codes		Kpye Manufacturing Except Saw Mills
	Codes		Codes		Per Capita of		
	Million pounds/year		Million pounds/year		Total Population		
						Kpyc	
Alabama	4,415		1,353		1.404		5.71
Alaska	151		40		.635		10.6
Arizona	708		282		.625		5.1
Arkansas	4,993		1,136		2.706		11.5
California	13,441		7,376		.938		5.8
Colorado	752		505		.569		6.0
Connecticut	1,967		1,904		1.398		4.7
Delaware	419		351		1.298		8.7
District of Columbia	283		283		1.385		13.2
Florida	2,808		2,030		.719		9.0
Georgia	5,375		2,129		1.350		6.1
Hawaii	191		191		.380		8.3
Idaho	2,102		205		3.157		6.9
Illinois	8,044		7,692		1.140		6.8
Indiana	3,641		3,244		.975		5.5
Iowa	1,362		1,220		.670		7.0
Kansas	680		632		.450		5.6
Kentucky	2,391		1,258		.945		7.3
Louisiana	3,559		1,097		1.145		9.0
Maine	2,225		1,455		2.471		15.4
Maryland	2,096		1,641		.976		6.6
Massachusetts	4,856		4,645		1.629		7.4
Michigan	5,821		4,770		1.049		5.1
Minnesota	2,075		1,626		.736		7.4
Mississippi	3,633		1,251		1.681		10.2

TABLE 3 (CONTINUED)

<u>State</u>	<u>Manufacturing Codes</u>	<u>Manufacturing Codes</u> <u>Except Saw Mills</u>	<u>All Codes Per Capita of Total Population</u> Kpyc	<u>Kpye Manufacturing Except Saw Mills</u>
	Million pounds/year	Million Pounds/year		
Missouri	3,543	2,779	.973	7.4
Montana	1,520	98	2.263	7.1
Nebraska	526	512	.514	8.5
Nevada	95	55	.382	8.1
New Hampshire	859	515	1.487	6.4
New Jersey	4,483	4,404	1.164	5.9
New Mexico	368	98	.485	7.3
New York	11,697	10,840	1.247	6.5
North Carolina	6,754	2,906	1.534	5.7
North Dakota	65	57	.181	9.6
Ohio	7,899	7,095	1.120	6.1
Oklahoma	931	610	.546	7.4
Oregon	10,228	769	5.393	7.0
Pennsylvania	9,285	7,751	1.261	5.9
Rhode Island	640	640	1.482	5.9
South Carolina	3,055	1,186	1.339	4.6
South Dakota	240	98	.467	8.2
Tennessee	4,499	2,806	1.404	8.7
Texas	5,302	3,186	.745	6.7
Utah	315	307	.474	6.4
Vermont	630	289	1.656	9.5
Virginia	5,396	2,033	1.436	7.1
Washington	5,532	1,174	2.021	6.3
West Virginia	2,081	823	1.272	7.5
Wisconsin	4,002	3,275	1.208	7.4
Wyoming	176	40	.643	10.1
U. S. Total	168,109	102,661	1.182	6.5

TABLE 4

SCRAP-AND-WASTE QUANTITIES AND UTILIZATION ACHIEVED¹

<u>S.I.C. Code Group</u>	<u>Sample Size</u>	<u>Known Scrap and Waste</u> <u>1965</u> <u>Million/lbs/yr</u>	<u>Fraction Utilized</u> <u>or Otherwise Not</u> <u>Waste-for-Disposal</u>	<u>Waste-for-Disposal</u> <u>1965</u> <u>Million/lbs/yr</u>
<u>MANUFACTURING</u>				
Food	14	11,500	0.08	10,570
Meats	10	2,963	0.44	1,659
Textile Mill Products, ex. 226, 8	10	2,629	.351	1,706
Apparel & Related Products, ex. 235, 7	9	981	.291	700
Wooden Containers	40	4,996	0.51	2,448
Saw Mills	65	192,600	0.66	65,484
Mill Work	9	1,072	0.47	558
Wooden Furniture	14	4,197	0.26	3,106
Paper	42	11,100	0.10	9,990
Printing & Publishing	9	7,243	0.68	2,318
Chemicals	11	2,625	0	2,525
Paints	8	324	0	340
Asphalt Roofing	7	1,180	0.03	1,145
Rubber	11	2,900	0	2,900
Tanning	7	608	0.02	596
Glass	7	3,200	0.16	2,688
Metal Cans, 3411	3	973	.812	183
Fabricated Metal Products & Machinery, ex. Electrical, 34 ex. 3411 ex. 345, 6, 7, 8, 9, & 35, ex. 364	18	12,337	.512	6,020
Electrical Machinery	20	3,651	.244	2,760
Auto & Aircraft	9	5,786	0.50	2,893
Sub Total, 20 Manufacturing Code Groups		272,865	.56	120,782
Sub Total, 19 Manufacturing Code Groups (except saw mills which is 54% of waste for disposal)		80,265	.31	55,182

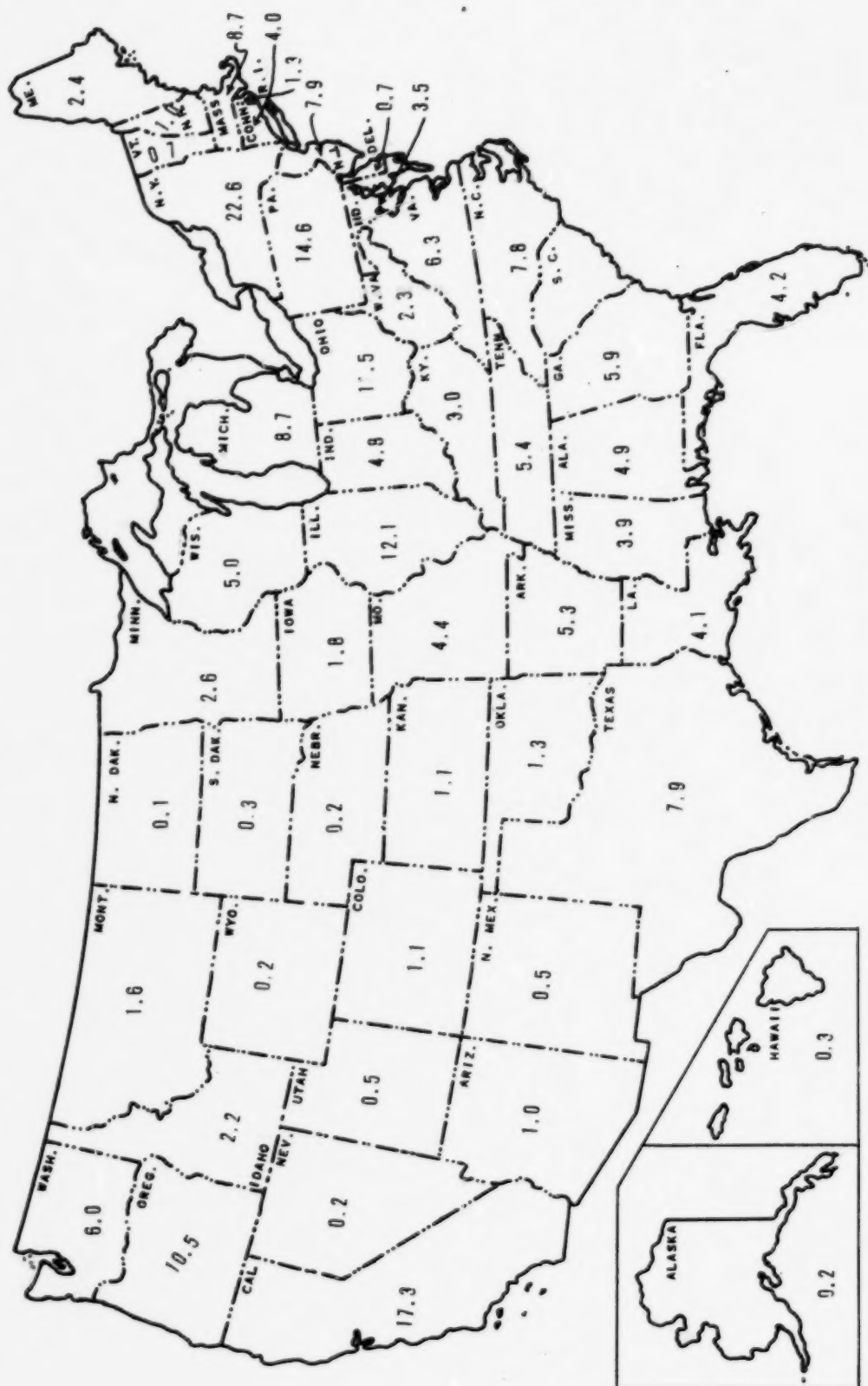
TABLE 4 (CONTINUED)

<u>S.I.C. Code Group</u>	<u>Sample Size</u>	<u>Known Scrap and Waste</u> <u>1965</u> <u>Million/lbs/yr</u>	<u>Fraction Utilized</u> <u>or Otherwise Not</u> <u>Waste-for-Disposal</u>	<u>Waste-for-Disposal</u> <u>1965</u> <u>Million/lbs/yr</u>
<u>NON-MANUFACTURING</u>				
Cotton Ginning	(4865)	3,836	0.59	1,573
Demolition	8	38,100	0	38,100
Stockyards (including auction)	11	1,919	0.61	748
Super Markets	11	33,800	0.40	20,280
Total, 24 Code Groups	293	350,520	.48	181,543
Sub Total, 23 Code Groups (except saw mills)		157,920	.27	115,943

ESTIMATED TOTAL ANNUAL MANUFACTURING SOLID WASTES FOR DISPOSAL¹

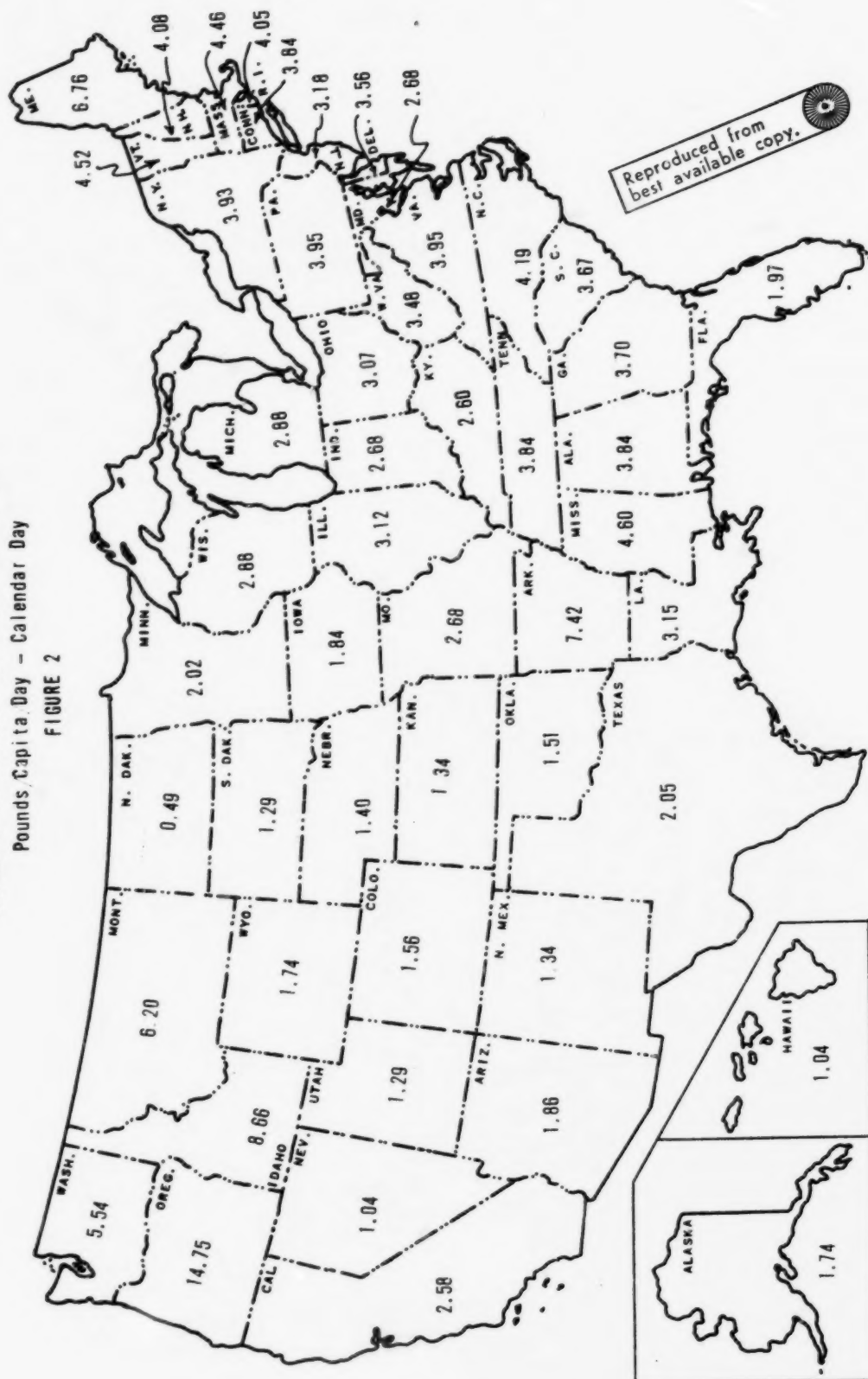
Pounds $\times 10^9$

FIGURE 1



ESTIMATED INDUSTRIAL SOLID WASTE GENERATION¹
Pounds/Capita/Day - Calendar Day

FIGURE 2



1968 National Solid Waste Survey

The Bureau of Solid Waste Management is conducting a national solid waste survey² through state planning grants. The survey deals primarily with municipal solid waste, but some data on industrial solid wastes was collected. Three different data collection forms are being used: community description, land disposal sites, and solid waste facilities. As of October 1968, 6,259 communities had been surveyed representing approximately 46.3 percent of the population of the United States.

Various types of information were obtained from responses to the forms. To clarify the responses, each type of form will be discussed separately regarding the type of information which was requested, types of forms used, and the information which was obtained by each form.

Community Description Form. This form is designed to obtain information on the types of regulations, and enforcement procedures which are applied to industrial solid waste management. Information is requested on the means of solid waste collection, including public, private or individual collectors. Data is obtained on the numbers of man years of compactor truck collection, and estimates are requested of industrial solid waste generated. Other questions include the following:

- a. What are the number of man years for collection?
- b. Is a compactor vehicle used?
- c. Is on-site burning allowed and regulated?
- d. Are communities budgeting for industrial waste collection and disposal?

Land Disposal Site Form. This form presents the following questions:

- a. Does the site have industrial area zoning?
- b. Does the facility accept industrial solid waste?
- c. Are any types of solid waste specifically excluded from the site?

Facility Investigation Form. This form covers any type of waste processing or disposal unit not covered by the land disposal form. Questions asked in the form are identical to those in the land disposal form.

Results from the national survey will add to our understanding of industrial solid wastes but because of the limitations of any large survey the data will be difficult to use. Solid waste practices are dependent upon local geographic factors, regulations and acceptable practices. Preliminary results from the national survey have been published by the Bureau ^{2,4}.

Responses from the survey indicated that 95 percent of on-site storage of industrial waste is regulated by the community. This result is based on a 75 percent response by the communities surveyed. Estimates of men and vehicles utilized for industrial solid waste collection by the public sector include:

1. 635 man years for drivers and collectors, based on a 75 percent response,
2. 88 compactor trucks, based on a 19.7 percent response,
3. 139 other vehicles, based on a 19.8 percent response.

Estimates of vehicles and men used by the private sector, based on a 35 percent response by the communities surveyed are as follows:

1. 4358 firms collecting waste,
2. 6350 man-years for drivers and collectors,
3. 1644 compactor trucks
4. 14,209 other vehicles.

Based on total response to the survey, the industrial solid waste generation rate is approximately 300 tons per year per 1000 population.

Case Studies

Quad-Cities, New Jersey

The Quad-City industrial survey⁵ was conducted as part of U.S. Public Health Service, Demonstration Grant No. 1-D01-SW-00026-01, Regional Solid Wastes Program for the cities of Patterson, Clifton, Passaic and Wayne, New Jersey. The industrial study was conducted to determine the types and quantity of industrial solid waste and disposal modes. The Quad-City data sheet is included in the appendix as an example of the type of data which was collected. Samples of wastes were collected at selected plants and the respective compositions were determined. The survey covered 31 percent of all industrial establishments and from these results projections were made for all industrial plants. Eleven broad industrial categories were used.

At least 20 percent of the plants in each category were included in the survey and in most cases more than 30 percent were interviewed (Table 5).

TABLE 5
 QUAD-CITY INDUSTRIAL INVENTORY ⁵
 SOLID WASTE GENERATION
 FOUR COMMUNITIES

<u>Industrial Category</u>	<u>No. Plants in Category</u>	<u>No. Plants Surveyed</u>	<u>Percent Surveyed</u>	<u>Adjusted Total Wastes lbs/week</u>
Metals	308	99	32	540,069
Paper	76	24	32	272,905
Textiles	376	80	21	236,346
Plastics	49	22	45	377,011
Food	32	13	41	77,040
Wood	30	11	37	53,469
Rubber	14	7	50	120,229
Chemicals	74	28	38	418,406
Glass	35	18	51	198,803
Leather	10	2	20	3,427
Miscellaneous	39	17	44	232,701

It was found that 324 plants surveyed generated a total of approximately 250 tons/day. Paper amounted to 180 tons/day. Approximately 85 percent of the waste was sent to landfills in Bergen County, New Jersey, 12 percent to landfills in other counties, and 3 percent to unidentified sites.

Calculated generation rates were used to project the waste in each category, on the basis of seven-day week. Results from this analysis indicate a figure of 3.31 pounds/capita-day industrial solid waste production for the area (Table 6).

Fresno, California

The Fresno Regional Study⁶ was conducted in 1966 by Aerojet-General Corporation for the California Department of Public Health under a Bureau of Solid Waste Management Demonstration Grant No. SW-00021. Volume II of the study deals with industrial solid waste management. Industrial solid waste management practices were found to vary widely from plant to plant depending on the practices of the individual plant managers. Most of the industries surveyed used open trucks for collection or handling. Detailed cost information was found to be unobtainable.

Four disposal practices were reported to prevail in the project area:

(1) salvage, (2) landfill including open dumps, (3) spreading, and (4) burning.

The amount to which each is practiced was highly dependent on the geographic location and other specialized conditions.

TABLE 6
 QUAD-CITY SOLID WASTES PROJECT ⁵
 INDUSTRIAL WASTE PRODUCTION
 BY
 COMMUNITY
 IN LBS/CAPITA -DAY

<u>Industrial Category</u>	<u>Clifton</u>	<u>Paterson</u>	<u>Passaic</u>	<u>Wayne</u>	<u>Quad-City</u>
Metal	.84	.80	.90	.14	.78
Paper	.70	.24	.10	--	.41
Textile	.27	.75	.35	--	.52
Plastic	.30	.35	.58	.52	.38
Food	.17	.09	.12	--	.10
Wood	.03	.11	.05	--	.05
Rubber	.03	.005	.52	.04	.10
Chemical	1.05	.09	.39	.05	.50
Glass	.22	.30	.05	.04	.17
Leather	--	.02	.002	--	.05
Miscellaneous	.17	.14	--	.80	.25
Totals	3.780	2.895	3.062	1.59	3.31

Landfilling and open dumping were found to be highly dependent upon the location of the disposal area with respect to the plant. Most of the industries surveyed had used a municipal disposal site at one time or open dumps in the vicinity of their own plant.

Spreading is a disposal method where solid wastes are used as a soil conditioner or road surfacing material. Canneries, cotton, oil, and ginning plants; wineries, and meat packing industries dispose of part or all of their wastes by spreading. Only certain types of wastes are used for road surfaces.

Open burning was reported to be practiced by certain industries, such as chemical, dairy, auto wrecking, and planing mills. Paper and cardboard were the primary wastes which were burned. Auto wreckers burn old tires and upholstery.

In the Fresno region salvage is a major activity of industrial solid waste management. The reason for this is the predominant type industries such as fruit and vegetable processing, wineries, meat packing and planing mills sell all or part of their processing wastes to the farmers or to other industries as a by-product.

An estimate of annual solid waste generation is presented in Table 7.

ESTIMATED INDUSTRIAL SOLID WASTE GENERATED IN FRESNO, CALIFORNIA AREA⁶

<u>SIC No.</u>		<u>tons/yr</u>
0712	Cotton Ginning and Compressing	300
0715	Fruit and Vegetable Packing	1,000
0723	Poultry Hatcheries; Infertile Eggs Shells	100 20
2011	Meat Packing, Manure	300
2020	Dairy Products	30
2033	Canned Fruit and Vegetables; Pits Culls	5,000 5,500
2034	Dried Fruit and Vegetables	25
2037	Frozen Fruit and Vegetables	8,000
2042	Prepared Animal Feed	50
2051	Wholesale Bakery Products	100
2084	Wines, Brandies, and Spirits	40,000
2086	Soft Drinks, Bottled	50
2874	Agricultural Chemicals	50
3444	Steel Metal Work	150
3551	Food Products Machinery	200
5048	Fresh Fruits and Vegetables	<u>1,500</u>
	TOTAL	62,375

All fruit and vegetable related solid waste show a large seasonal variation.

Bullitt County, Kentucky

The Bullitt County Survey⁷ was conducted by the Division of Technical Operations, Bureau of Solid Waste Management. The industrial inventory portion is presented since it exemplifies the type of small industry present in rural counties. Bullitt County is located twenty miles south of Louisville, Kentucky and has a population of 21,750 people. The major industries are a distillery employing 400 to 600 people, a publishing company with 100 employees and a hardware manufacturing company employing 37. Other industries employ less than 15 employees each and encompass such areas as lumber, job printing, and concrete products. Approximately 572 employees are engaged in Bullitt County manufacturing operations. These industries generate approximately 12,200 pounds/week or 2,250 pounds/day of solid wastes.

Jefferson County, Kentucky

As part of a demonstration grant (D01-SW-00007-01) for a solid waste study of Jefferson County, Kentucky⁸, an industrial solid waste survey was conducted. A short questionnaire was sent to all industries. Better than eighty percent response was received. Follow-up interviews were used when necessary.

The total industrial solid waste in Jefferson County amounted to 1.24 million pounds per day or 226,200 tons per year. The present disposition of waste is 62 percent collected by private or municipal haulers, 19 percent disposed of by industry on their own property and 19 percent salvaged. Minerals, paper, wood, and foodstuffs are the predominate types of waste.

The mineral waste is primarily large quantities of refractory sand. The amount of solid waste disposal on plant property was larger than investigators expected and indicates the amount that may someday have to be handled by municipal or private facilities.

State of Pennsylvania

The Division of Sanitation, Commonwealth of Pennsylvania⁹, is presently conducting an inventory of practices and management of industrial solid waste. The inventory will survey, county by county, a representative sample of industry in terms of size and type. It is being conducted by personal interview to collect data dealing with type, volume, salvage, collection, disposal, and cost. The survey will cover about 15 percent of all industry in Pennsylvania. Projection of the total amount of industrial types and volumes will be based on the data from the survey.

Projections will provide a basis for making predictions, decisions, or actions required in an environmental health management program by identifying solid waste generators.

Table 8 is presented as an example of the industrial solid waste data which is being gathered.

TABLE 8
PENNSYLVANIA INDUSTRIAL DATA⁹

SIC No.	Industry Type	Waste	Quantity	Hazardous	Storage	Collection	Disposal
3316	Steel	Acid Oil Metal Scale Trash	22,250 gal 108 gal 200 tons 320 tons 200 tons		Tank	Tank Truck	Neut. Pits *Landfill
2011	Meat	Manure Intestines Trash Sawdusts Blood	400 tons 30 tons 1.5 tons 1,700 cu yds		Bulk Bulk Bin Bin Tank	Open Truck Open Truck Open Truck Open Truck Tank Truck	Open Dump Burning Open Dump
2026	Dairy	Trash Metal Process	3,500 cu yds 39 cu yds 24 tons	No No No		Dump Truck Dump Truck Dump Truck	Farm Farm Animal Feed
3255	Refractory	Paper Plaster Metal	3 tons 50 tons 5 tons	No No No			Dump Dump Salvaged
2751	Printing	Trash	400 cu yds	No	Containers	Compactor	Landfill

RECLAMATION OF INDUSTRIAL SOLID WASTES

Large quantities of industrial solid waste must be disposed of even though some reuse is being practiced. The solution to the growing solid waste problem is not disposal but reuse, recycle or reclamation of the major portions of the waste. Two prime efforts of the Bureau of Solid Waste Management are the reclamation of industrial solid wastes and the identity of solid waste management practices within various industries.

As pointed out in a recent survey of the chemical industry¹⁰, an economic solution to the solid waste problem is presently being sought. The use of a modern, pollution-free municipal incinerator would be a solution, but has many disadvantages because of the present state-of-the art and the heterogeneity of the wastes.

The system used by Eastman Kodak Company¹¹ to recover silver from the ash of incinerated sensitized material, copper from electric wires after burning off the insulation, and recovery of metal drums after incinerating the solidified contamination is much better than disposal. When technically and economically feasible, such a system should be used.

Another example of reclamation is the use DuPont¹⁰ makes of its chlorinated waste, which is burned followed by the recovery of hydrochloric acid. This is done without creating air or water pollution problems.

The opposite approach to recycling is taken by the Hooker Chemical Company¹² which, after prolonged study and investigation, constructed a commercial plant for disposal of chlorinated organic residues. Although the direct

cost is 50% less for this method than drum burial, it still remains that some type of recovery utilization would be more economical. They do state that recovery of HCl and heat from their reactor would increase initial capitalization but such cost may be justifiable. A minimum of one tone of hydrochloric acid and 10,000 pounds of steam could be recovered.

Another industry where progress has been made in recycling industrial solid waste is the tobacco products industry. The progress in reclamation has been due mainly to the high cost of tobacco leaf. In essence, the stem portion of the leaf and other natural tobacco waste which was previously considered waste is now processed, similarly to paper pulp, into a roll of tobacco sheet. The manufactured tobacco sheet is finding increased use as a substitute for natural tobacco, primarily in cigars, as a binder and wrapper material. It is also reported to result in producing less tars and nicotine when used in cigarettes.

Another example of industrial solid waste reclamation presently being reported is the conversion of cellulosic wastes into single cell proteins which are then made into "foods". Although presently used for very specific cellulose waste, investigators think the method has application with waste paper and eventually municipal solid waste¹³. Louisiana State University¹⁴ is designing a pilot plant to convert cellulose waste products into a low cost, high protein food. The work is supported by a contract from the Bureau of Solid Waste Management. In addition a research grant to LSU is seeking to identify other microorganisms that can degrade cellulose and to refine the processing techniques and analyze the protein products for digestibility and meet nutritional value.

The pilot facility will grind, chemically treat and sterilize a variety of cellulose wastes--sugar cane, bagasse, grass, hay, corn stalks, cotton vines, wood chips, and newspaper. The resultant material will be fed to a fermenter, where micro-organisms will degrade and metabolize the cellulose component. The microorganisms, when dried will contain about 50 percent crude protein by weight. This edible end product (a single cell protein) is straw colored with a texture similar to rough flour. The plant is designed to produce 20 to 40 pounds per day of crude protein which should be competitive with both soybean flour and corn meal.

To illustrate the potential for industrial recycling and reuse we can consider the following examples:

1. Waste rubber can be added to asphalt batching for road surfaces¹⁵.
2. The residue obtained from the manufacture of Bourbon is dried, fortified and used for animal feed. It is packaged in sack lots and also in bulk quantities¹⁶.
3. The meat industry (slaughter, packing and processing) lends itself to collection and use of waste products. Rendering of edible and inedible fats is the largest waste utilization process¹⁶. Once fertilizer was an important by-product of the wastes, but not with higher grade tankage, the waste is used more for stock feed. Bones, floor scraps and other inedible trimming from the processing of smoked meats and sausages are sold to venders.

The recycling of industrial solid waste should be the ultimate objective of any management program. Recycling is desirable in order to conserve our resources and reduce the cost of transporting and disposing of the solid wastes. Table 4 from the Combustion Engineering survey indicates an estimated reuse fraction by SIC industrial groups.

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APPENDIX

INDUSTRIAL CHECK LIST¹

Establishment Data

Type of Establishment _____

Products _____

SIC Code Classification _____

Other SIC Codes Produced _____

Plant Capacity
(product quantity, specify units) _____

Number of Employees _____ total _____ production

Seasonality (of production plant)

 Operating season _____

 Hours/day _____

 Days per week _____

 Weeks per year _____

Changes in production pattern which would influence employee number per unit output, waste production or disposal during next ten years? (automation, process changes, product requirements, waste utilization, etc.)

Industrial solid wastes will be generated by the following sources and must be researched individually (unless lumped together for disposal):

1. Office waste and general plant rubbish (lunch containers, paper, etc.)
2. Shipping waste, in and out (pallets, boxes, containers)
3. Process wastes
4. Solid waste collected by air cleaning devices
5. Solid waste collected by liquid cleaning devices

For each of the above waste streams, obtain:

Character

Description

% Moisture

Type of organic

Bulk density

Other

Present Disposition

A. Sold

How much of it

For what use

Price

F.O.B.

Quantity per day

Future

B. Municipal Disposal

Quantity per day

Collected by city?

Hauled by self?

How far?

How many loads/day

Future

C. Contract Disposal

Quantity per day

How transported

C. Contract Disposal (contd.)

Ultimate disposal
(city or private dump or incinerator) _____

Future _____

D. Self-disposal

Method _____

If Incinerator

Make _____

Age _____

Size _____ tons per day

Crew _____

Operating hours _____

Vehicle load _____

Cost (installed) _____

Satisfaction _____

Future _____

If open dumping, landfill or open burning:

Quantity _____

How far _____

Vehicle loads _____

Crew _____

Cost _____

Air Pollution
Requirements _____

E. Future Plans

Hypothetical Incinerator practice

Hours/day _____

Days/week _____

- F. Identify and obtain quantity, disposition and future disposition of liquid wastes which are disposed of by means other than sewers (i.e. incinerated, landfill, etc.)

DATA SHEET
INDUSTRIAL SOLID WASTES
QUAD-CITY SOLID WASTES PROJECT⁵

Prepared by: _____

Date: _____

Name of Company _____

Address _____

Street

City

Zip

Phone No. _____

Names and Titles: Persons furnishing information

Major Products or Business _____

Total Waste Production Per Week _____ Pounds _____ Tons _____ Cubic Yards

Estimate of Types of Waste Material by Class:

% of Total

Paper and Paper Products
Plastic and Plastic Products
Metal and Metal Products
Ceramic Products
Organic Chemicals
Inorganic Chemicals
Petro Chemicals - Petroleum Products
Textiles, Rags and Apparel
Lumber and Wood Products
Leather and Leather Products
Rubber and Rubber Products
Mixed Commercial
Glass and Glass Products
Stone, Sand, Plaster
Food - Vegetable and Animal Processing
Miscellaneous - Not Otherwise Classified

Estimate Percentage of Waste (Total = _____ per Week)

Handled and disposed of on premises _____

Carted away from premises _____

WASTES HANDLING:

On Premises - By Dump _____ Sanitary Fill _____ Fuel _____

Incineration _____ Open Burning _____

Chemical Conversion _____ Salvage _____

Other _____

(Either check or indicate Estimate of Percentage of Total)

Description of Disposal Unit (Area, Capacity, Manufacturer, Model)

Off Premises

Cartage by Owner _____ Private Scavenger _____

Municipality _____

Name of Scavenger _____

Address of Scavenger _____

Collections Per Week. Number _____

Days of Collection _____

Wastes Carted to Dump _____ Sanitary Landfill _____

Incinerator _____ Other _____

Name and Location of Disposal Area(s)

ESTIMATES OF COST OF SOLID WASTE HANDLING:

\$ _____ Annual

\$ _____ Per Ton

_____ Other Basis (i.e. per unit
of Product or Raw Material)

(If split Methods of Disposal provide similar data on each and indicate
tonnage so handled.)

NOTES:

All information will be kept strictly confidential.